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Study of Earthquake Source and Crustal Structure in the New Madrid Seismic Zone Region

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3-D P- and S-wave Velocity Structures in the Sedimentary Basin of the Upper Mississippi Embayment

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ABSTRACT

3-dimensional P- and S-wave velocity structures of the sedimentary basin in the upper Mississippi embayment have been constructured using priori information including (1) a few well logs, (2) the geological formation and layer boundaries (Mihill, 1998), (3) the very shallow P and S wave velocities (e.g. Liu, et al., 1997; Berman et al., 1999; Wood et al., 1999) and (4) the arrival time differences between the direct S and the converted S_p waves from the bottom of the sedimentary basin (Chen et al., 1996). In general, the sedimentary basin can be subdivided into eight layers of various thickness and seismic wave velocity from the correlations between lithological formation and well-log information (Mihills, 1998). Assuming a constant V_p/V_s ratio inside each individual layer of the same geological formation, V_p/V_s ratio for each layer can be determined from a linear inversion. The resultant V_p/V_s varies from 6.6 in the uppermost layer to 1.8 in the lowermost layer. V_p vary vertically from $\sim$ 1.0 km/sec at the top layer to $\sim$ 2.6 km/sec at the bottom layer beneath which V_p increases to 5.9 $\sim$ 6.0 km/sec. The 3rd and 7th layers appear to be regions of lower V_p. Lateral variations of V_p inside layers are mostly in the range of 0.2 $\sim$ 0.4 km/sec. The V_s increases from $\sim$ 0.15 km/sec at the uppermost layer to 1.37 km/sec at the deepest layer. Lateral variations of V_s inside each layer are similar to that of the V_p. Three-dimensinal V_p and V_s structures in the upper Mississippi embayment can thus be constructed. The complexity of vertically and horizontally varied seismic wave velocities inside the sedimentary basin can not be overlooked in traditional earthquake location and regional ground motion simulation.